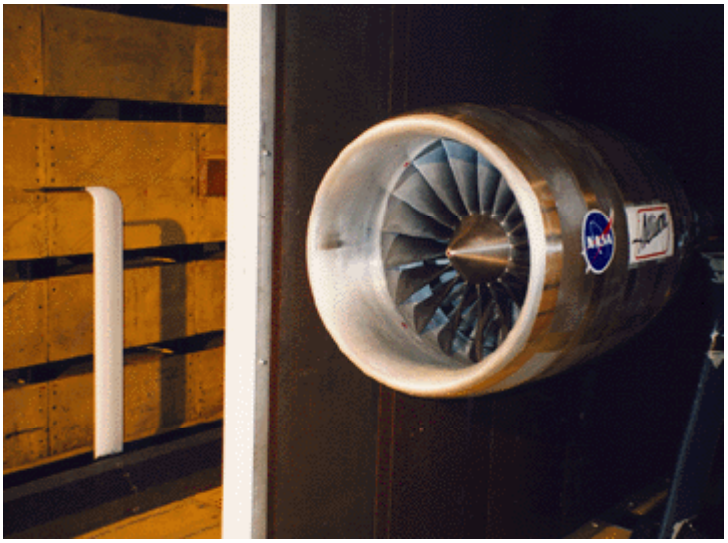
Acoustic Barrier Facilitates Inlet Noise Measurements for Aft-Dominated Fans

Noise levels for modern high-bypass-ratio subsonic turbofans tend to be aft dominated. That is, the highest flyover noise levels radiate from the fan exit. Measuring fan inlet sound radiation without aft radiation contamination requires selective suppression of the aft noise. In NASA Lewis Research Center's 9- by 15-Foot Low-Speed Wind Tunnel, an acoustic barrier was used to effectively isolate the inlet noise field for a model of an advanced turbofan. This proof-of-concept test was performed on a model turbofan manufactured for NASA Lewis by the Allison Engine Company as part of the Advanced Subsonic Technology program.

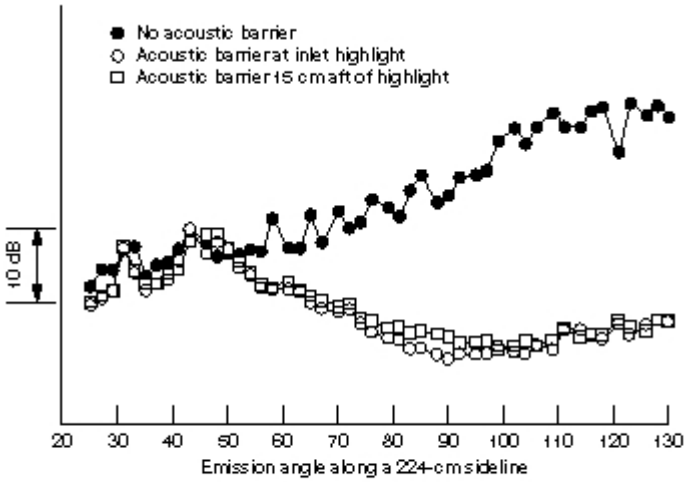
The 8-cm-thick acoustic barrier was constructed in sections that were joined upon installation. These sections, which were composed of a wood frame with typically 0.64-cm tempered fiberboard skins, extended from the tunnel's floor to its ceiling and had an axial length of 61 cm. On the fan side of the barrier just downstream of the leading edge, the upstream section had an acoustic treatment--a bulk absorber with a perforated metal skin. It had a nominal full height and an axial length of 46 cm. In addition, an elliptical leading edge was faired into the upstream barrier section. The barrier was mounted on tracks on the tunnel floor and ceiling at a sideline distance of 15 cm from the fan nacelle. Tests were made with the barrier leading edge at the fan inlet highlight plane and 15 cm further aft. The barrier extended downstream essentially to the end of the treated tunnel test section.



Allison model turbofan in Lewis' 9- by 15-Foot Low-Speed Wind Tunnel. Acoustic barrier shown installed.

In this photograph, the acoustic barrier is shown in the upstream position. Acoustic data were taken with a translating microphone on a 224-cm sideline. The directivity plot shows the aft fan noise suppression due to the barrier along the 224-cm sideline. Data are for one-third octave band levels at 6300 Hz, which correspond to the second harmonic of the fan

rotor-stator interaction tone. Results are shown for the fan without the barrier present and with the barrier leading edge at the two axial test locations. Aerodynamic data indicate that the barrier does not influence the performance of the fan.



Aft fan noise suppression due to the wall along the 224-cm sideline.